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Management of Soybean White Mold

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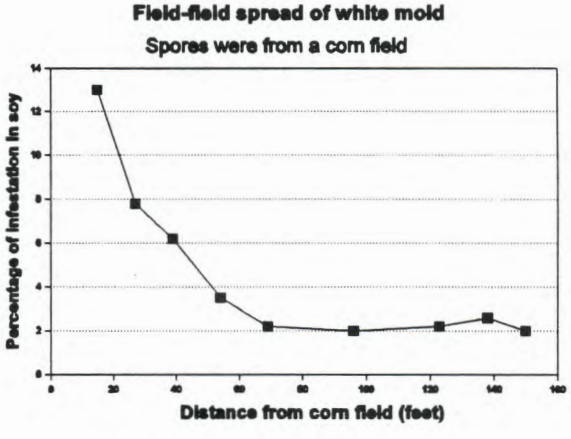
Status of white mold in Iowa

In the 1996 field season, white mold was prevalent in many Iowa soybean fields at much greater levels than in 1992 and 1994. This outbreak may be attributed to the high moisture (rain and heavy dew) and cool temperature in August. Compared with 1994, the disease differences were 1) a greater number of severely infested fields with sizes ranging from 50 to 100 acres have been observed, and 2) the disease occurred further south. Although the disease was observed in counties as far south as hwy 34 in 1994, no severe damage was reported. This year severe infestation occurred in a number of soybean fields along hwy 34. Our data indicates that the disease is here to stay, and very likely to increase in the future if we do not manage it properly. Two strategies are proposed to manage the disease: prevent the introduction of the pathogen into noninfested soybean fields, and control the build-up of the pathogen in fields where the pathogen has been introduced.

Prevention of the spread of white mold

White mold was not observed in the majority of Iowa soybean fields, therefore preventing the spread of this disease into non-infested fields is important. To do so, we need to consider four major means for introduction of this disease.

Seed. The fungus has a special structure called sclerotium which is the same size as soybean seeds (This fungal structure looks similar to a mice dropping). When harvesting soybean, a combine can not separate sclerotia from the seed. Sclerotia carried with the seed has proved effective in dissemination of the disease. Use of contaminated seed will spread the pathogen from one field to another. Besides producing sclerotia, the fungus also can infect and survive in the seed. Although information is not available on whether infested soybean seeds can disseminate white mold into a new crop, seeds of low quality from white mold infested fields should not be used. If one wants to save seed from a white mold infested field, seed testing is recommended. ISU Seed Science Center provides such service at a reasonable cost.



Spores from adjacent fields. Because white mold spores are airborne during the growing season, they are one of the major sources for local dispersal of white mold from field to field. The spores can be from an infested soybean field or corn field which had white mold in the past. Our studies (Fig. 1, Wegulo and Yang, unpublished) show that spores

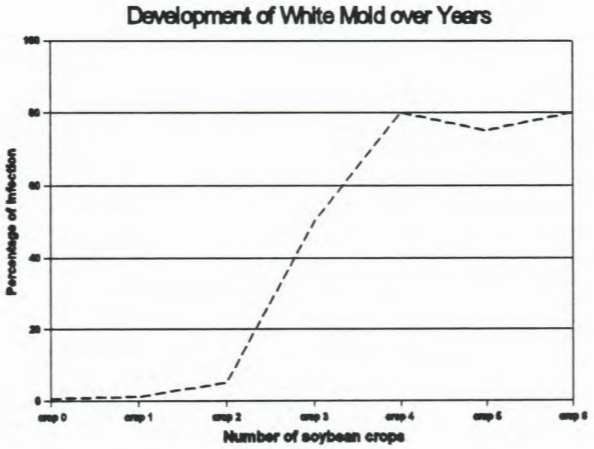
produced in a corn field can spread into a soybean field as far as 150 feet away. In many cases, the infestation by spores from an adjacent field cause little damage to the yield. However, sclerotia formed after the infestation would serve as inoculum for the future increase and damage.

Manure. The association of white mold occurrence and manure application was observed again this year. Although there is not much information on the spread of the fungus with manure in soybean production, it is documented in other crops that cattle manure can spread the disease. So, one should avoid using soybean straw from white mold infested fields for bedding.

Harvest equipment. Combines can be a means to spread disease into uncontaminated fields. The white mold fungus produces many sclerotia as survival structures. Sclerotia are present in soybean stems and debris, which can be carried by combines from one field to other fields during harvest. So if you have a field severely infested with white mold, this diseased field should be the last to harvest. If this approach is not feasible, clean the debris out of the combines after harvesting white mold infested soybean fields. Further, if the disease is present in one or two patches in a soybean field, always harvest the diseased patches last which can help prevent the spread of infested crop debris to other parts of soybean field.

Risk Assessment

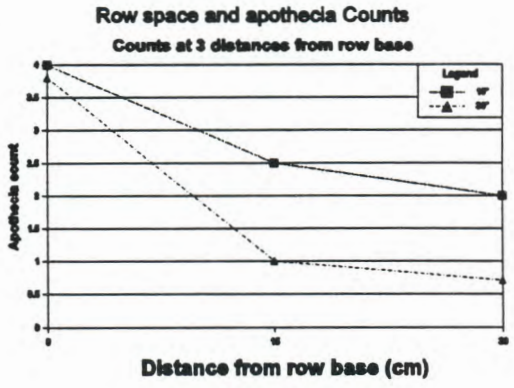
White mold fungus may produce millions of aerially dispersed spores form a single sclerotia, which explains the high risk nature of this disease. This year, many growers who had severe white mold problems stated that they did not see the disease in 1994. It is likely that the level of disease was low in 1994 and, therefore, the disease had been ignored. After the disease is introduced into a field, it would not take many soybean crops to become prevalent. When the level of infestation is under 10 diseased plants per hundred plants, the disease usually is ignored because healthy plants cover the diseased ones. The second figure, developed based on epidemiological theory and observations, describes how the disease develops if no management measures are taken. It only takes one soybean crop for the white mold to build up to 50% kill from a level of 5-10% infestation. Early detection and knowledge how to assess the future white mold risk is critical.



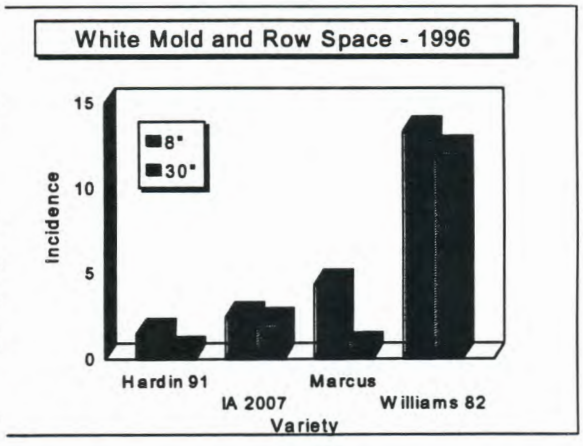
The level of risk depends on how much white mold you had in the past, how the disease distributed in you field, and the soil moisture. Moist (not saturated) and fertile soils are ideal for white mold. Under good soil conditions, if less than 1% of plants were infested this year, the risk is minimum. If about 5% of plants are infested but aggregated in small spots, the risk is limited to those portions of your soybean field. If infestation was 5% but scattered over an entire field, the risk is high if a susceptible variety is planted. If your soybean had more than 10% of white mold infestation, the risk of white mold for next soybean is very high, assuming a susceptible variety

is used.

New Management Information



Row space. Studies on row spacing consistently show that white mold infestation is higher in narrow row soybeans than wide row soybeans. Narrow row conditions favor apothecia (a tiny mushroom like structure which produces spores) production (see upper figure). Our 1994 and 1995 results showed an increase in infestation of white mold in narrow compared with 30" row. However, when weather conditions are favorable to white mold, such as this year, wide row (30") would have same level of disease as the narrow row space (see lower figure). Further, if pathogen population is high, significant damage may still occur in wide row soybean.



Tillage. Tillage practice affects the white mold but there are no good recommendations on how to use tillage to manage the disease because of the unique features of this disease. The sclerotia can survive in deep soil up to seven years. Only sclerotia within 2-inches of the soil surface germinate and release spores to infect soybeans. Burying infested residues by mold-board plow or deep chisel can prevent the germination of the sclerotia the next year. But the effectiveness of control by burying sclerotia is affected by cultivation and tillage in following season. Cultivation, or tillage operations in the following seasons would uncover sclerotia. Further, if your soybean fields already had white mold in the past, sclerotia may already be buried in the soil. White mold spores are airborne and each small mushroom produce 3 million spores. It does not take many sclerotia per square foot to cause damage.

Variety selection.

Use of tolerant varieties has been proved effective in managing white mold by Wisconsin producers. Founded by Iowa Soybean Promotion Board, we tested 63 entries of soybean for tolerance to soybean white mold in the 1996 growing season. These entries include varieties from private and public sectors. A few entries are lines soon to be released as new varieties. Experiments were conducted at the Humboldt research plot and the ISU Kanawha Research Farm. At both locations, disease pressure was extremely high. At Humboldt, the susceptible varieties had 80% of plants killed. At Kanawha, highly susceptible varieties had 68% of plants killed. See attached tables for detailed information.

Tolerance of each variety was measured as percentage of plants killed. The fewer plants killed for a variety, the higher the tolerance. In other words, the higher the rank, the greater the tolerance. The number of plants killed differed between locations because of varying disease pressure. To select

varieties, one should compare the percentage of dead plants with that of the most susceptible varieties and look for consistency in tolerance rankings.

Information on yield in absence of white mold is from 1995 ISU uniform yield test. Studies of other states show that when the percentage of plants killed is about 10%, the yield loss is not measurable, and yields are sometimes higher than the disease free control. Plant pathology documents show that loss is often insignificant in soybean when the percentage of plants killed is less than 20%.

Prescriptive Management

Selection of effective management depends on the level of risk which is assessed based on the disease incidence of previous soybean crops. Keep in mind that the assessment is made in an assumption that conditions are favorable to disease development. Certainly not all fields have white mold favorable conditions. Following are the management options made according to disease incidence of previous crop.

Incidence much smaller than 1%. The risk is low for next soybean crop. Monitor the disease closely. You may see more disease but under a damaging level in next soybean. No special control measure is recommended. If white mold indeed increases in next soybean crop, action should be followed.

Light disease with 1-5% incidence with disease in small patches. The risk of having severe damage for next soybean crop is small. The disease damage would be limited in these small patches if susceptible varieties are used. The disease would continue to increase if susceptible varieties are used and your fields have the right soil conditions for white mold. You should monitor the spread of this disease closely.

Light disease (5% incidence) scattered throughout the fields. The risk of significant damage is low when tolerant varieties are used. But the risk is high when highly susceptible varieties are used and your field have the right soil conditions. To manage the disease, use of tolerant varieties is the first choice. If a field had 10-30% of infection, the risk of severe damage for next soybean is high.

Severe white mold (more than 40%). High incidence in past suggested your fields have right soil conditions. The risk of severe damage may be high even in a normal year. Management should be aimed at reducing the fungal population for future production. Rotation with corn or other non-host crops for 2 years can reduce white mold population. Use no-tillage in non-host season helps sclerotia germination, which reduces white mold population in the long run. When back to soybean, use of tolerant varieties is recommended.

Tolerance of Iowa Soybean Varieties to White Mold, 1996 - Kanawha

Company	Variety	Rank	Plant killed (%)
Pioneer Hi-Bred Int'l Inc.	9163	1	0.5
	Dassel	2	1.6
	Corsoy79	3	2.8
Northrup King Company	S19-90	4	2.8
Custom Farm Seed	CFS 181	5	3.4
Terra International, Inc.	TS194	6	4.5
Asgrow Seed Co	A 2506	7	6.1
Asgrow Seed Co	A 1900	8	6.8
Hy-Vigor Seeds	1150	9	7.1
	Parker	10	7.4
Midwest Seed Genetics	G 1885	11	7.8
DEKALB Plant Genetics Co.	CX173	12	10.4
AgriPro Seeds, Inc.	AP1876	13	13.1
Dairyland Seed Company	DSR-277	14	13.9
Mark Seed Co.	MRK 9519	15	15.0
Gutwein & Sons, Inc.	7200	16	15.6
Latham Seed Company	720 Brand	17	15.8
Latham Seed Company	440 Brand	18	15.9
Sands of Iowa, Inc	SOI 260	19	16.3
Stine Seed Co.	01526-84	20	16.5
Kruger Seed Co.	K1990	21	16.8
Mark Seed Co.	MRK 9227	22	16.8
Sands of Iowa, Inc	SOI 242	23	16.9
Stine Seed Co.	1970	24	18.1
Marlin Wilkin & Sons	MWS261	25	18.3
	BSR101	26	18.4
Custom Farm Seed	CFS196	27	18.6
Merschman Seeds	ex01018-E	28	19.1
	Bell	29	19.9
Lynks Seeds	5269	30	20.6
	Kenwood	31	20.6
LG Seeds, Inc./Masco	LG 6275	32	21.1
AgriPro Seeds, Inc.	AP1995	33	21.6
	IA2007R	34	21.8
Merschman Seeds	ex16726-60	35	22.0
Lewis Hybrids, Inc.	283	36	23.4
Story Brand Seeds	ST 203	37	23.8
Marlin Wilkin & Sons	MWS271	38	24.4
Sieben Hybrids, Inc	SS 320STS	39	25.4
Fontanelle Hybrids	5304	40	26.4
Dairyland Seed Company	DSR-220 STS	41	26.6
ICI Seeds, Inc.	D337	42	26.9
Stine Seed Co.	2671	43	27.1
Sieben Hybrids, Inc	SS 273	44	27.5
ICI Seeds, Inc.	D278	45	28.8
DEKALB Plant Genetics Co.	CX232	46	29.4
Kruger Seed Co.	K-2595	47	33.8
Midwest Seed Genetics	G 2818	48	35.0
Stine Seed Co.	15733-79	49	35.3
Story Brand Seeds	ST 225	50	35.3
Terra International, Inc	TS223	51	35.9
Kruger Seed Co.	K-2343+	52	39.6
Fontanelle Hybride	2221	53	40.9
Gutwein & Sons, Inc	7275STS	54	41.3
Latham Seeds	580 Brand	55	44.4
LG Seeds, Inc./Masco	LG 6244	56	45.0
FS Hisoy (GROMARK)	HS2317	57	50.6
Pioneer Hi-bred Int'l., Inc	9254	58	51.3
	Williams82	59	53.8
Lewis Hybrids, Inc.	276	60	60.0
Asgrow Seed Co.	A 2242	61	64.0
Lynks Seeds	5223	62	65.6
FS Hisoy (GROMARK)	FS HiSoy 2230	63	68.1

Tolerance of Iowa Soybean Varieties to White Mold, 1996-Humboldt (Contin')

Company	Variety	Rank	Plants killed (%)	Maturity Estimate	Source*	Yield Bu/Ac	Iowa 1995 Tests
	Corsoy79	1	8.0	2.1	3	55.0/55.4	NE,NL
	Dassel	2	9.3	1.1	3		
Asgrow Seed Co.	A 2506	3	10.0	2.5	1		
Custom Farm Seed	CFS 181	4	10.0	1.8	1		
Hy-Vigor Seeds	1150	5	11.3	1.5			
Sands of Iowa, Inc.	SOI 260	6	12.5	2.0	1		
Mark Seed Co.	MRK 9519	7	13.0	2.0	1	60.6	NE
Pioneer Hi-Bred Int'l, Inc.	9163	8	13.8	1.6	1		
Midwest Seed Genetics, Inc.	G 1885	9	14.3	1.9	1		
Stine Seed Co.	01526-84	10	16.3	-			
Terra International, Inc.	TS194	11	17.5	1.9	1	62.7	NE
Northrup King Company	S19-90	12	17.5	1.9	3	58.1	NE
Kruger Seed Co.	K-1990	13	18.8	1.9	1	62.1	NE
AgriPro Seeds, Inc.	AP1876	14	18.8	1.8	1		
Asgrow Seed Co.	A 1900	15	20.0	1.9	1		
Gutwein & Sons, Inc.	7200	16	20.0	2.0	1		
	Parker	17	23.8	1.4	3	58.4	NE
AgriPro Seeds, Inc.	AP1995	18	25.0	1.9	1	64.1	NE
DEKALB Plant Genetics Co.	CX173	19	26.3	1.7	1		
	BSR101	20	27.5	1.9	3	57.5	NE
Merschman Seeds	ex01018-E	21	30.0	-			
Latham Seed Company	440 Brand	22	31.3	2.1	1	57.1	NE
Dairyland Seed Company	DSR-220 STS	23	32.5	2.2	1	55.3/56.3	NL,CE
Sieben Hybrids, Inc.	SS 273	24	32.5	2.7	1		
	Kenwood	25	33.8	2.1	3		
Story Brand Seeds	ST 203	26	35.0	1.9	1		
Sands of Iowa, Inc.	SOI 242	27	36.3	2.2	1		
Custom Farm Seed	CFS196	28	37.5	1.9	1		
Dairyland Seed Company	DSR-277	29	40.0	2.7	1	58.1/53.9	CL,SE
	IA2007R	30	40.0	2.6	2	58.1/49.3	CL,SE
Lynks Seeds	5269	31	40.0	2.6	1	54.3/58.4	NL,CE
Marlin Wilkin & Sons	MWS271	32	40.0	2.7	1		
Merschman Seeds	ex16726-60	33	40.0	-			
Mark Seed Co.	MRK 9227	34	41.3	-			
Lewis Hybrids, Inc.	283	35	42.5	2.8	1		

Tolerance of Iowa Soybean Varieties to White Mold, 1996-Humboldt (Contin')

Company	Variety	Rank	Plants killed (%)	Maturity Estimate	Source*	Yield Bu/Ac	Iowa 1995 Tests
Stine Seed Co.	2671	36	42.5	2.6	1		
	Bell	37	42.7	1.6	3	52	NE
Kruger Seed Co.	K-2595	38	43.8	2.4	1		
Stine Seed Co.	15733-79	39	43.8	-			
Latham Seed Company	720 Brand	40	45.0	2.7	1	57.9/57.4	NL,CE
Midwest Seed Genetics, Inc.	G 2818	41	47.5	2.8	1	62.7	CL
LG Seeds, Inc./Masco	LG 6275	42	47.5	2.7	1	60	CE
Stine Seed Co.	1970	43	48.8	-			
Kruger Seed Co.	K-2343+	44	52.5	2.2	1	63.3/63.8	NL,CE
ICI Seeds, Inc.	D278	45	52.5	2.7	1	59.3	CL
Marlin Wilkin & Sons	MWS261	46	53.8	2.6	1		
Terra International, Inc.	TS223	47	56.3	2.2	1		
LG Seeds, Inc./Masco	LG 6244	48	57.5	2.4	1	59.9/59.4	NL,CE
Latham Seed Company	580 Brand	49	57.5	2.2	1	57.6	NL
DEKALB Plant Genetics Co.	CX232	50	58.8	2.3	1	60.7/58.9	NL,CE
ICI Seeds, Inc.	D337	51	58.8	3.3	1	59.0/54.0	CL,SE
FS Hisoy (GROWMARK)	HS2317	52	58.8	2.3	1		
Sieben Hybrids, Inc.	SS 320STS	53	58.8	3.2	1		
Fontanelle Hybrids	2221	54	60.0	2.3	1		
FS Hisoy (GROWMARK)	FS HiSoy 2230	55	61.3	2.2	1	58.4	NE
Pioneer Hi-Bred Int'l., Inc.	9254	56	65.0	2.6	1	58.2/57.7	NL,CE
Fontanelle Hybrids	5304	57	65.0	3.3	1		
Story Brand Seeds	ST 225	58	66.3	2.0	1		
Gutwein & Sons, Inc.	7275STS	59	68.8	2.7	1		
Asgrow Seed Co.	A 2242	60	70.0	2.2	3		
Lewis Hybrids, Inc.	276	61	71.3	2.7	1		
	Williams82	62	78.8			43.9	SL
Lynks Seeds	5223	63	82.5	2.4	1	60.2	NE